CHAPTER

3

TABLE OF CONTENTS

HIGHWAY DESIGN STANDARDS

The Louisiana Department of Transportation and Development has adopted certain design standards for highways and roads. The following four (4) broad classifications have been established to classify our highways.

1. FREEWAYS
2. ARTERIAL ROADS AND STREETS
3. COLLECTOR ROADS AND STREETS
4. LOCAL ROAD AND STREETS

The classification applicable to any given segment of road has been established by the Traffic and Planning Section, and is available from maps and other publications such as the "Highway Needs Summary". The "Local" standards are generally applicable to off-system roads.

Within each classification, three (3) to six (6) sub-categories have been established. The designer may exercise some discretion and/or the pre-design committee in selecting the appropriate sub-category to be used for design based on factors such as:

1. TRAFFIC
2. TERRAIN
3. EXISTING ROADSIDE DEVELOPMENT
4. DESIGN CONTINUITY
5. OTHER PERTINENT FACTORS DESIGN STANDARDS FOR FREEWAYS

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
DESIGN STANDARDS FOR FREEWAYS

ITEM NO.	ITEM	F-1	F-2	F-3
1	Design Speed (K/H)	80 (1)	100	120
2	Level of Service	C (2)	C (2)	B (3)
3	Number of Travel Lanes (Minimum)	4	4	4
4	Width of Travel Lanes (m)	3.6	3.6	3.6
5	Width of Shoulders (Where Used) (m)			
	(A) Outside	3.0 (4)	3.0 (4)	3.0 (4)
	(B) Median	1.8 (5)	1.8 (5)	1.8 (5)
6	Type of Shoulders	Paved	Paved	Paved
7	Width of Median (m)			
	(A) Depressed	15 Min.	20 - 27	21 - 27
	(B) Continuous Barrier (4 Lane)	4.2 (6)	4.2 (6)	4.2 (6)
	Continuous Barrier (6 Lane)	8.0 (6)	8.0 (6)	8.0 (6)
8	Fore Slope - Ratio	4:1 - 6:1	6:1	6:1
9	Back Slope - Ratio	4:1	4:1	4:1
10	Pavement Cross Slope (m per m)	0.025 (7)	0.025 (7)	0.025 (7)
11	Stopping Sight Distance (m)	120-140 (8)	160-210 (8)	210-290 (8)
12	Maximum Superelevation (m per m)	0.10	0.10	0.10
13	Max. Horizontal Curvature (With Superelevation) (m) (9)	220	360	595
14	Maximum Grade (%)	4 (10)	3 (10)	3 (10)
15	Minimum Vertical Clearance (m)	4.9 (11)	4.9 (11)	4.9 (11)
16	Width of Right of Way (m)			
	(A) Depressed Median	As Needed	90	90
	(B) Median Barrier	As Needed	As Needed	As Needed
	(C) Minimum From Edge of Bridge Structure	4.5 - 6.0	4.5 - 6.0	4.5 - 6.0
17	Bridge Design Load	HS-20	HS-20	HS-20
18	Width of Bridges (m)(Min.)(Face to Face Bridge Rail)	12.0	12.0	12.0
19	Guardrail Required at Bridge Ends	Yes	Yes	Yes
20	Horizontal Clearance (m)(From Edge of Travel Lane)			
	(A) 4:1 Foreslope	9.0	N/A	N/A
	(B) 6:1 Foreslope	7.0	10.0	10.5

Numeric Ranges Indicate Minimum - Desirable.

(1) For Use In Urban Areas Only.

(2) Level of Service D Permissible For Heavily Developed Urban Areas.

(3) Level of Service C Permissible For Urban Conditions.

(4) 3.6m Paved Required With Truck DDHV Greater Than 250.

(5) 1.2m To Be Paved; 3.0m To Be Paved On 6 Lane Facilites; 3.6m To Be Paved On 6 Lane Facilites With Truck DDHV Greater Than 250.

(6) 10.0 Maximum.

(7) 2% Permissible For Rehabilitation Projects.

(8) Minimum Values Shown Permissible For Rehabilitation Projects. Maximum Values Shown To Be Used Where Conditions Permit.

(9) It May Be Necessary To Increase The Radius Of The Curve And/Or Increase The Shoulder Width (Maximum of 3.6m) To Provide Adequate Stopping Sight Distance On Structure.

(10) Grades 1% Higher May Be Used In Special Cases.

(11) 150mm Additional To Allow For Future Surfacing; 5.2m Required For Trusses and Pedestrian Overpasses.

DESIGN STANDARDS

Approved Dempsey D. White Chief Engineer 10-8-93 Date

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
DESIGN STANDARDS FOR ARTERIAL ROADS AND STREETS

ITEM NO.	ITEM	RURAL				URBAN (1)	
		TWO LANE		FOUR LANE			
		RA-1	RA-2	RA-3 (2)	RA-4	UA-1	UA-2
1	Design Speed (K/H)	100	110	100	110	60	70
2	Design Hourly Volume	0-600 (3)	0-600 (3)	601-2300	601-2500	N/A	N/A
3	Level of Service	B	B	B	B	C (4)	C (4)
4	Number of Travel Lanes	2	2	4 (5)	4 (5)	2Min.-4Typ.	2Min.-4Typ.
5	Width of Travel Lanes (m)	3.6	3.6	3.6	3.6	3.3 - 3.6	3.6
6	Width of Parking Lanes (Where Used) (m)	N/A	N/A	N/A	N/A	3.0 - 3.6	3.0 - 3.6
7	Width of Shoulders (Where Used) (m)						
	(A) Outside	2.4 - 3.0	3.0	3.0	3.0	N/A	N/A
	(B) Median	N/A	N/A	1.8 (6)	1.8 (6)	N/A	N/A
8	Type of Shoulders	Paved	Paved	Paved	Paved	N/A	N/A
9	Width of Median (m)						
	(A) Depressed	N/A	N/A	12 - 20	20	N/A	N/A
	(B) Raised	N/A	N/A	N/A	N/A	1.2 - 9.0	1.2 - 9.0
	(C) Two Way Left Turn Lanes	N/A	N/A	N/A	N/A	3.3 - 4.3	3.3 - 4.3
10	Width Of Sidewalk(Where Used)(Offset From Curb) (m)	N/A	N/A	N/A	N/A	1.2	1.2
	Width Of Sidewalk(Where Used)(Adjacent From Curb)(m)	N/A	N/A	N/A	N/A	1.8	1.8
11	Fore Slope - Ratio	6:1	6:1	6:1	6:1	3:1 - 4:1	3:1 - 4:1
12	Back Slope - Ratio	4:1	4:1	4:1	4:1	3:1	3:1
13	Pavement Cross Slope (m per m) (7)	0.025	0.025	0.025	0.025	0.025	0.025
14	Stopping Sight Distance (m) (8)	160 - 210	180 - 250	160 - 210	180 - 250	80 - 90	100 - 120
15	Maximum Superelevation (m per m)	0.10	0.10	0.10	0.10	0.04	0.04
16	Max. Horiz. Curvature(W/out Superelevation)(+.025) (m) (9)	N/A	N/A	N/A	N/A	175	N/A
	Max. Horiz. Curvature(W/out Superelevation)(-.025) (m) (9)	N/A	N/A	N/A	N/A	220	N/A
17	Max. Horizontal Curvature(With Superelevation) (m) (9)	360	500	360	500	160	235
18	Maximum Grade (%)	3 (10)	3 (10)	3 (10)	3 (10)	7	6
19	Minimum Vertical Clearance (m) (11)	4.9	4.9	4.9	4.9	4.9	4.9
20	Minimum Horizontal Clearance (m)						
	(A) From Edge of Travel Lane	9.0	10.0	10.0	10.5	N/A	N/A
	(B) Outside (From Back of Curb)	N/A	N/A	N/A	N/A	1.8 - 4.6	1.8 - 4.6
	(C) Median (Where Used)(From Back of Curb)	N/A	N/A	N/A	N/A	1.2 - 4.6	1.2 - 4.6
21	Minimum Width Of Right of Way (m) (12)(13)						
	(A) From ℄	23	23	As Needed	38	N/A	N/A
	(B) From Edge of Travel Lane	N/A	N/A	N/A	N/A	2.4 - 5.2	2.4 - 5.2
22	Bridge Design Load	HS-20	HS-20	HS-20	HS-20	HS-20	HS-20
23	Width of Bridges (m) (Min.)(Face to Face Bridge Rail)	Shldr. Width	13.2	12.0	12.0	Rdwy.+ 2.4 (14)	Rdwy.+ 2.4 (14)
24	Bridge End Treatment Required at Bridges	Yes	Yes	Yes	Yes	Yes	Yes

Numeric Ranges Indicate Minimum - Desirable.

(1) Applies To Curbed Sections Only. For Uncurbed Sections Use Rural Standards.

(2) Used When Adding Two Lanes To Existing Two Lane Facility.

(3) For Rolling Terrain, Limited Passing Sight Distance and High Percentage Trucks, 4 Lanes May Be Required When DHV is Above 400.

(4) Level Of Service D Permissible In Heavily Developed Areas.

(5) Consider Increasing To 6 Lane Facility When DHV is Above Figure Shown in Item No. 2.

(6) 1.2m Paved.

(7) 2% Permissible For Rehabilitation Projects.

(8) Minimum Values Shown Permissible For Rehabilitation Projects. Maximum Values Shown To Be Used Where Conditions Permit.

(9) It May Be Necessary To Increase The Radius Of The Curve And/Or Increase The Shoulder Width (Maximum of 3.6m) To Provide Adequate Stopping Sight Distance on Structure.

(10) 4% Permissible In Rolling Terrain.

(11) 150mm Additional To Allow For Future Surfacing.

(12) Minimum Required For New Location and As Needed For Existing Alignment.

(13) Obtain Additional Right of Way For Future Lanes Where Justified.

(14) For Approach Roadways Without Curb, Use Shoulder Width. 1.8m Sidewalk Behind Curb To Be Carried Across Bridge When Justified By Pedestrian Traffic.

DESIGN STANDARDS

Approved Dempsey D. White, Chief Engineer 10-8-93 Date

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
DESIGN STANDARDS FOR COLLECTOR ROADS AND STREETS

ITEM NO.	ITEM	RURAL			URBAN		
		RC-1	RC-2	RC-3	UC-1	UC-2	UC-3
1	Design Speed (K/H)	100 (1)	100 (1)	100	50	60	70
2	Current Average Daily Traffic	0-400	Over 400	Over 400	N/A	N/A	N/A
3	Design Hourly Volume	N/A	100-200	Over 200	N/A	N/A	N/A
4	Level of Service	C	C	C	D	D	D
5	Number of Travel Lanes	2	2	2 to 4 (2)	2 to 4	2 to 4	2 to 4
6	Width of Travel Lanes (m)						
	(A) With Curb	N/A	N/A	N/A	3.0 - 3.6	3.0 - 3.6	3.6
	(B) With Shoulder	3.3	3.3	3.6	3.3 - 3.6 (3)	3.3 - 3.6 (3)	3.6
7	Width of Parking Lanes (Where Used) (m)	N/A	N/A	N/A	2.4 - 3.0	2.4 - 3.0	2.4 - 3.0
8	Width of Shoulders (Where Used) (m)						
	(A) Outside	0.6 - 1.2	1.8 - 2.4 (4)	2.4 - 3.0 (4)	2.4	2.4 - 3.0 (5)	2.4 - 3.0 (5)
	(B) Median	N/A	N/A	1.2	N/A	N/A	1.2
9	Type of Shoulders	Aggregate	Agg. - Pav.	Paved	Paved	Paved	Paved
10	Width of Median (m)						
	(A) Depressed	N/A	N/A	12.0 - 18.0	N/A	N/A	N/A
	(B) Raised	N/A	N/A	N/A	1.2 - 9.0	1.2 - 9.0	1.2 - 9.0
	(C) Two Way Left Turn Lanes	N/A	N/A	N/A	3.3 - 4.3	3.3 - 4.3	3.3 - 4.3
11	Width of Sidewalk (Where Used)(Offset From Curb)(m)	N/A	N/A	N/A	1.2	1.2	1.2
	Width of Sidewalk (Where Used)(Adjacent To Curb)(m)	N/A	N/A	N/A	1.8	1.8	1.8
12	Fore Slope - Ratio	4:1	4:1	6:1	3:1 - 4:1	3:1 - 4:1	3:1 - 4:1
13	Back Slope - Ratio	3:1	4:1	4:1	2:1 - 3:1	2:1 - 3:1	3:1
14	Pavement Cross Slope (m per m) (6)	0.025	0.025	0.025	0.025	0.025	0.025
15	Stopping Sight Distance (m) (7)	160 - 210	160 - 210	160 - 210	60 - 70	80 - 90	100 - 120
16	Maximum Superelevation (m per m)	0.10	0.10	0.10	0.04	0.04	0.04
17	Max. Horiz. Curvature (W/out Superelevation)(+.025)(m) (8)	N/A	N/A	N/A	85	175	N/A
	Max. Horiz. Curvature (W/out Superelevation)(-.025)(m) (8)	N/A	N/A	N/A	105	220	N/A
18	Max. Horizontal Curvature (With Superelevation)(m) (8)	360	360	360	80	160	235
19	Maximum Grade (%)	7	6	5	9	9	8
20	Minimum Vertical Clearance (m)	4.6	4.6	4.6	4.6	4.6	4.6
21	Minimum Horizontal Clearance (m)						
	(A) From Edge of Travel Lane	9	9	9	(9)	(9)	(10)
	(B) Outside (From Back of Curb)	N/A	N/A	N/A	0.3 - 1.8	0.3 - 1.8	1.8 - 4.6
	(C) Median (Where Used)(From Back of Curb)	N/A	N/A	N/A	0.3 - 1.8	0.3 - 1.8	1.2 - 4.6
22	Width of Right of Way (m) (Minimum) (11) (12)						
	(A) From ℄	18	18	23	N/A	N/A	N/A
	(B) From Edge of Travelway	N/A	N/A	N/A	2.4 - 3.4	2.4 - 3.4	2.4 - 5.2
23	Bridge Design Load	HS-20	HS-20	HS-20	HS-20	HS-20	HS-20
24	Width of Bridges (m) (Min.)(Face to Face Bridge Rail)	9	Shldr. Width (13)	Shldr. Width	Rdwy.+ 2.4 (14)	Rdwy.+ 2.4 (14)	Rdwy.+ 2.4 (14)
25	Bridge End Treatment Required at Bridges	YES	YES	YES	YES	YES	YES

Numeric Ranges Indicate Minimum - Desirable.

(1) For Spot Projects, Lesser Design Speeds May Be Used When Conditions Require.

(2) For Rolling Terrain, Limited Passing Sight Distance and High Percentage Trucks, 4 Lanes May Be Required When DHV is Above 700.

(3) For DHV > 400 Use 3.6m Lanes.

(4) For Spot-Replacement Bridge Projects Where No Future Improvements To The Roadway Are Planned, Construction May Be To The Design Minimums.

(5) For DHV > 400 Use 3.0m.

(6) 2% Acceptable For Rehabilitation Projects.

(7) Minimum Values Shown Permissible For Rehabilitation Projects. Maximum Values Shown To Be Used Where Conditions Permit.

(8) It May Be Necessary To Increase The Radius Of The Curve And/Or Increase The Shoulder Width (Maximum of 3.6m) To Provide Adequate Stopping Sight Distance on Structure.

(9) If Not Curbed, Clearance = 3m

(10) If Not Curbed, Clearance = 6m

(11) Minimum Required For New Location And As Needed For Existing Alignment.

(12) Obtain Additional Right of Way For Future Lanes Where Justified.

(13) 9.0m Minimum Width Is Allowable With Aggregate Shoulders. 11.4m Required For Paved Shoulders.

(14) For Approach Roadways Without Curb, Use Shoulder Width. 1.8m Sidewalk Behind Curb To Be Carried Across Bridge When Justified By Pedestrian Traffic.

DESIGN STANDARDS

Approved Donnie W. White, Chief Engineer 10-8-93 Date

LOUISIANA DEPARTMENT OF TRANSPORTATION AND DEVELOPMENT
DESIGN STANDARDS FOR LOCAL ROADS AND STREETS

ITEM NO.	ITEM	RURAL			URBAN	
		RL-1	RL-2	RL-3	UL-1	UL-2
1	Design Speed (K/H) (1)	50	65	80	30	50
2	Current Average Daily Traffic	0-250	250-400	Over 400	N/A	N/A
3	Design Hourly Volume	N/A	N/A	Over 100	N/A	N/A
4	Level of Service	D	D	D	D	D
5	Number of Travel Lanes	2	2	2	2	2
6	Width of Travel Lanes (m)	2.8	3.0	3.3 (2)	2.8 - 3.6	2.8 - 3.6
7	Width of Parking Lanes (Where Used) (m)	N/A	N/A	N/A	2.1 - 2.7	2.1 - 2.7
8	Width of Shoulders (Where Used) (m)	0.6	0.6	1.8 - 2.4 (3)	N/A	N/A
9	Type of Shoulders	Aggregate	Aggregate	Aggregate (4)	N/A	N/A
10	Width of Sidewalk (Where Used)(Offset From Curb)(m)	N/A	N/A	N/A	1.2	1.2
	Width of Sidewalk (Where Used)(Adjacent To Curb)(m)	N/A	N/A	N/A	1.8	1.8
11	Fore Slope - Ratio (5)					
	(A) Cut	3:1 (6)	4:1	4:1	3:1	3:1
	(B) Fill	3:1 (6)	4:1	4:1	3:1	3:1
12	Back Slope - Ratio (5)	2:1	2:1	3:1	2:1	2:1
13	Pavement Cross Slope (m per m) (7)	0.025	0.025	0.025	0.025	0.025
14	Stopping Sight Distance (m)	60 - 70	90 - 110 (8)	120 - 140 (8)	30	60 - 70
15	Maximum Superelevation (m per m)	0.10	0.10	0.10	0.04	0.04
16	Max. Horiz. Curvature (W/out Superelevation)(+.025)(m) (9)	N/A	N/A	N/A	25	85
	Max. Horiz. Curvature (W/out Superelevation)(-.025)(m) (9)	N/A	N/A	N/A	30	105
17	Max. Horizontal Curvature (With Superelevation) (m) (9)	75	140	220	24	80
18	Maximum Grade (%)	9	9	8	10	9
19	Minimum Vertical Clearance (m)	4.6	4.6	4.6	4.6	4.6
20	Minimum Horizontal Clearance (m)					
	(A) From Edge of Travel Lane	3.0	3.0	3.0	N/A	N/A
	(B) From Back of Curb	N/A	N/A	N/A	0.3 - 1.8	0.3 - 1.8
21	Bridge Design Load	HS-20	HS-20	HS-20	HS-20	HS-20
22	Width of Bridges (m) (Min.)(Face to Face Bridge Rail)	6.8	7.3	Rdwy.+ 1.8 (10)	Rdwy.+ 2.4 (11)	Rdwy.+ 2.4 (11)
23	Bridge End Treatment Required at Bridges	Yes	Yes	Yes	Yes	Yes

Numeric Ranges Indicate Minimum - Desirable.

(1) Shall Not Be Less Than The Speed For Which The Road Or Street Is To Be Posted, Upon Completion Of The Project.

(2) 3.6m Lanes Required For DHV Over 200.

(3) For DHV > 400 Use 2.4m Shoulder.

(4) Paved Shoulders Required For DHV Over 200.

(5) Side Slopes As Steep As 1:1 May Be Used, If Necessary, To Stay In Existing R/W.

(6) For Gravel Roads, 2:1 Acceptable.

(7) 2% Permissible On Rehabilitation Projects.

(8) Minimum Values Shown Permissible For Rehabilitation Projects. Maximum Values Shown To Be Used Where Conditions Permit.

(9) It May Be Necessary To Increase The Radius Of The Curve And/Or Increase The Shoulder Width (Maximum of 3.6m) To Provide Adequate Stopping Sight Distance On Structure.

(10) Use Shoulder Width For DHV of 400 or More.

(11) For Approach Roadways Without Curb or Sidewalk, Use Rural Standards.

GENERAL NOTES :

These Standards Shall Not Apply To:
(a) Dead - End Roads (Open At One End Only)
(b) Roads Which Are Dependent On Dead - End Roads For Access.

Urban Standards May Be Applied To Any Street For Which Curb Is To Be Used, Or Any Street For Which A Posted Speed of 50 K/H Or Less Would Be Appropriate.

Overlay Design Standards (Separate Sheet) Shall Be Applicable To Those Projects For Which The Primary Purpose Is To Improve The Riding Surface.

The Appropriate Local Governing Body Is Authorized To Make Design Exceptions For Specific Items Listed In These Standards, With Proper Engineering Justification.

Sheet 4 of 4

DESIGN STANDARDS

Approved Dempsey D. White (Chief Engineer) 10-8-93 Date

STRUCTURE NO._____

CHECK LIST FOR DISTRICT WHILE REVIEWING PROPOSED CONSTRUCTION SITES.

1. Are there debris or obvious scour problems ?

2. Does the site get inundated? If so, do other areas of the roadway within eight (8) km get inundated ?

3. Would it be possible to close the road during the construction period ?

4. Where are the utilities located relative to the existing structure ?

5. If a detour is to be required, which side of the existing structure would you recommend ?

6. Are there any obstructions other than utilities within 150 m of the existing structure ?

7. If alternate routes are available for detour purposes, is there any construction scheduled for these routes ?

8. Are there any churches, schools, parks, or recreational facilities in the vicinity of the proposed project ?

9. Are there any existing conditions which would prevent the replacement of the bridge with a pipe ?

10. Are there any wetlands, hazardous waste sites, above ground storage tanks, water wells, cemeteries, or historical sites in the area of the project ?

LIST OF PUBLICATIONS USED IN THE DESIGN OF BRIDGE STRUCTURES

	PUBLICATION	ORGANIZATION	Address
1	Standard Specifications For Highway Bridges	AASHTO	444 N. Capitol St., NW Suite 249, Washington, DC 20001
2	LRFD Bridge Design Specifications	AASHTO	" "
3	A Policy on Geometric Design of Highway and Streets	AASHTO	" "
4	Guide For Selecting, Locating and Designing Traffic Barriers	AASHTO	" "
5	Guide Specifications For Bridge Railing	AASHTO	" "
6	Bridge Welding Code	AASHTO, AWS, ANSI	" " "
7	Roadside Design Guide	AASHTO	" " "
8	Structural Welding Code	AWS (American Welding Society)	550 NW Lejeuene Rd. PO Box 351040 Miami, FL 33135
9	Guide Specification For Seismic Design of Highway Bridges	AASHTO	444 N. Capitol St., NW Suite 249 Washington, DC 20001
10	Guide Specifications For Fracture Critical Nonredundant Steel Bridge Members	AASHTO	"
11	Guide Specifications For Horizontally Curved Highway Bridges	AASHTO	"
12	Standard Specifications For Movable Highway Bridges	AASHTO	"
13	Guide Specifications And Commentary For Vessel Collision Design Of Highway Bridges	AASHTO	"
14	Guide Specifications for Strength Design of Truss Bridges	AASHTO	"
15	Standard Specifications For Structural Supports, Highway Signs, Luminaries and Traffic Signals	AASHTO	444 N. Capitol St., NW Suite 249 Washington, DC 20001
16	A Guide To Standardized Highway Lighting Pole Hardware(Task Force 13)	AASHTO, ARTBA, AGC	525 School St. SW Washington, DC 20402
17	MUTCD (Manual on Uniform Traffic Control Devices)	FHWA (Superintendents of Documents)	U.S.G.P.O. Washington, DC 20402
18	Bridge Design Manual	LADOTD	General Files PO Box 94245 Baton Rouge, LA 70804
19	All Bridges Design Revisions Subsequent To This Manual	LADOTD	"
20	Hydraulics Manual	LADOTD	"
21	Roadway Plan Preparation Manual	LADOTD	"

LIST OF CONSTRUCTION SPECIFICATIONS MANUALS

1	Louisiana Standard Specifications For Roads and Bridges	LADOTD	General Files PO Box 94245 Baton Rouge, LA 70804
2	Manual For Quality Control For Plants & Products Of Precast-Prestressed Concrete Products	PCI Prestressed Concrete Institute	20 North Wacker Drive Chicago, IL 60601

IT IS THE RESPONSIBILITY OF THE ENGINEER TO UTILIZE THE MOST UP -TO-DATE COPIES OF ALL APPLICABLE SPECIFICATIONS LISTED HEREIN.

LIST OF PUBLICATIONS USED AS GUIDES IN THE DESIGN OF BRIDGE STRUCTURES

	PUBLICATION	ORGANIZATION	Address
1	Highway Curves	Authors: Ives,Kissam Publisher: John Wiley & Son, Inc.	
2	Moments, Shears and Reactions For Continuous Highway and Bridges	AISC (American Institute of Steel Construction)	PO Box 806276 Chicago, IL 60680
3	Manual of Steel Construction Ninth Edition	AISC (American Institute of Steel Construction)	"
4	ACI Code	ACI American Concrete Institute	PO Box 19150 Redford Station Detroit, MI 48219
5	ACI Manual of Concrete Practice	ACI	"
6	Notes on Load Factor Design For Reinforced Concrete Bridge Structures With Design Applications	PCA Portland Cement Association	Old Orchard Road Skokie, IL 60076
7	PCI Design Handbook Precast and Prestressed Concrete	PCI Prestressed Concrete Institute	20 North Wacker Drive Chicago, IL 60601
8	CRSI Handbook	CRSI (Concrete Reinforcing Steel Institute)	180 North LaSalle Street Chicago, IL 60601
9	Manual Of Standard Practice (Rebar)	CRSI (Concrete Reinforcing Steel Institute)	"
10	Manual of Standard Practice (Welded Wire Fabric)	WRI (Wire Reinforcing Institute, Inc.)	7900 Westpark Drive Mclean, VA 22102
11	Manual Of Steel Construction Allowable Stress Design and Load and Resistance Factor Design	AISC American Institute of Steel Construction	PO Box 806276 Chicago, IL 60680
12	Highway Structures Design Handbook	USS (AISC Marketing Inc.)	Suite 750 650 Smithfield St. Pittsburgh, PA 15222
13	Steel Sheet Piling Design Manual	USS	"
14	Steel Sheet Piling Handbook	USS	"

LIST OF MATERIALS SPECIFICATIONS MANUALS

1	ASTM Standards	ASTM	100 Barr Harbor Ave. W. Conshochocker, PA 19428-2959
2	AASHTO Materials	AASHTO	Box 19150, Redford Station Suite 225 Detroit, MI 48219
3	Qualified Products List	LADOTD	Materials Section PO Box 94245 Baton Rouge, LA 70804-9425

LIST OF BRIDGE RATING AND BRIDGE INSPECTION MANUALS

1	Manual For Condition Evaluation Of Bridges	AASHTO	Box 19150, Redford Station Suite 225 Detroit, MI 48219

FOR A COMPLETE LISTING OF AASHTO PUBLICATIONS FOR HIGHWAY DESIGN, CONTACT AASHTO.

IT IS THE RESPONSIBILITY OF THE ENGINEER TO UTILIZE THE MOST UP -TO-DATE COPIES OF ALL APPLICABLE SPECIFICATIONS LISTED HEREIN

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BRIDGE SPECIFIC DESIGN CRITERIA

LOADING

All bridges on freeways, arterials or collectors shall be designed to carry HST-18(M) loading as well as MS-18 loading. See section on "Special Loading Considerations".

BRIDGE WIDTH

Shoulder widths on the inside of horizontal curves may need to be increased from the values shown herein in order to meet horizontal stopping sight distance requirements. See section on "Stopping Sight Distance for Barrier Rail Clearance".

A minimum clear roadway width of 9.0 m shall be used for bridges on collector roads. For temporary travel lanes, it is desirable to meet the lane widths as indicated for typical detour details, (types, A, B, C, &D). For instances when constraints may warrant a narrower condition, such as during phased construction, the engineer may utilize a narrower width without a design exception. The width shall be acceptable to all parties at the plan-in-hand meeting and shall take into account local conditions such as farm equipment crossing the structure.

BRIDGE FINISH GRADE ELEVATION

In general, finish grades of bridges should be set with the following criteria as a guide:

Hydraulic Criteria

1. If debris is a consideration, the finish grade should be set to provide 0.6 m of freeboard between the bottom chord and the design year flood. The bottom chord should clear the 100 year flood elevation by 0.30 m.

2. If debris is not a consideration, the finish grade should be set to provide 0.30 m of freeboard between the bottom chord and the design year flood. The bottom chord should clear the 100 year flood elevation.

3. On minor bridge replacement jobs, with the approval of the bridge design engineer, criteria 1 and 2 may be relaxed under the following conditions:

    a) Applying criteria 1 and 2 would result in a substantial raise to the approaching roadway grade.

    b) The bridge replacement is a spot replacement with no future plans to raise the approaching roadway.

Overpasses

See normal highway clearances in this chapter.

TYPICAL ORDER FOR BRIDGE PLAN SHEETS

Plan sheets shall be organized to facilitate construction. Shown below is an example for a moderate size project.

1. General Notes, Summary of Quantities and Bridge Index
2. General Plan
3. Superelevation Transition Detail
4. Detour Layout
5. Foundation Layout
6. Pile Data Sheet
7. End Bent Details
8. Intermediate Bent Details
9. Bent Elevations and Layout Sheets
10. Column Details
11. Framing Plan
12. Girder Details
13. Span Details[1]
14. Miscellaneous Span and Girder Details
15. Approach Slab Details
16. Joint Details
17. Optional Span Details
18. Standard Pile Details
19. Bridge End Drain Details
20. Core Borings & Test Piles

[1] Steel Span Details can be grouped together and include; typical sections, pouring sequence, framing plans, camber diagrams, girder details showing all connections, splices and bearing details.

PROCEDURES FOR REVISIONS AND PLAN CHANGES

DEFINITIONS

Revisions

Any change made to the plans after they have been signed by the Chief Engineer and prior to the letting is classified as a revision.

Plan Change

Any change made to the plans after the project has been let to contract is classified as a plan change.

REVISION PROCEDURES

In the event that a revision is required, a written request for the plans must be submitted to the General Files Section along with an approval of the Contracts Engineer in order to receive the plans from General Files. This request must specify the nature of the intended revision, the anticipated amount of time required, and the name of the person in charge of the revision. A speed letter will suffice for this request.

When a revision is made, a circle with a number inside is used to "bug" the change and to reference it to the revision block. All sheets involved in the revision will have the same numerical bug and date. All sheet numbers are to be recorded on the title sheet revision block including the title sheet numbers.

Once the revision is completed, the cost estimate should be revised as required, and the plans and estimate sent to the Contracts and Specifications Section for review. Once accepted by the Contracts and Specification Section, the person in charge and Chief Engineer shall sign the title sheet and the plans returned to General Files.

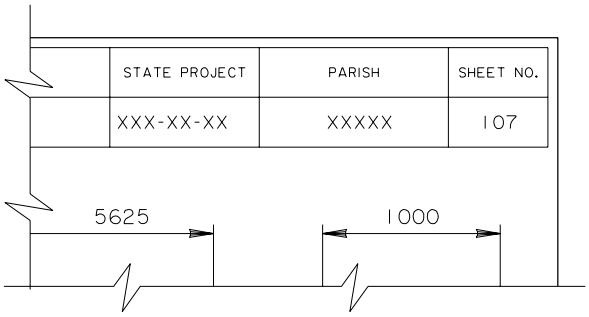
PLAN CHANGE PROCEDURES

For a plan change, the plans may be verbally requested from the General Files Section. A triangle with a number inside should be used to "bug" the change and reference it to the revision block. Plan changes are not recorded on the title sheet revision block. No erasures are allowed for a plan change. For minor changes, the changes are superimposed on the existing sheet. In the case of major changes, new sheets may be created and added to the plans. If a new sheet is created to replace an existing sheet, the old sheet is stamped "VOID". The replacement sheet will have an "A" added to the sheet number. Once the plan change is finalized, a letter must be sent to the Construction Section transmitting 18 sets of prints of all affected sheets explaining the plan change. A set of prints will be transmitted to the Project Engineer by copy of the letter. If consultants are involved, a separate set of plans should be transmitted to the consultant by copy of the letter sent to the Construction Section. If Real

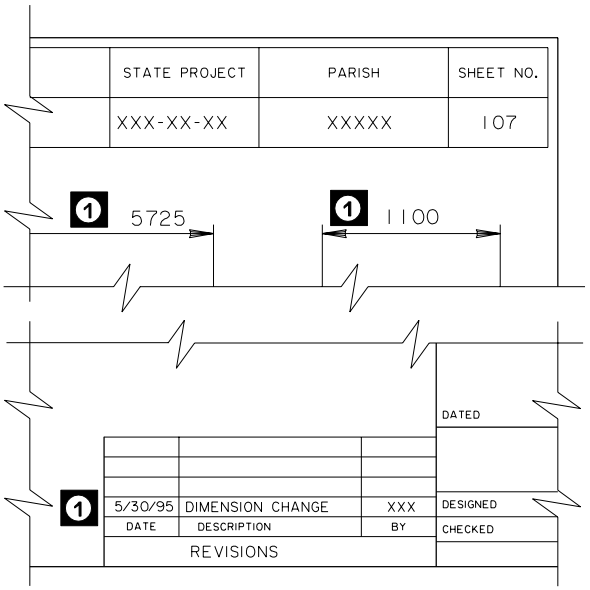
Estate and Utilities are involved, full-sized sets are to be transmitted, 10 sets to Real Estate and 1 set to Utilities, by copy of the letter. (See example)

1. IF MINOR REVISIONS ARE NEEDED, MAKE CHANGES ON THE ORIGINAL SHEET. ERASURES ARE ALLOWED. FOR EXAMPLE:

ORIGINAL SHEET

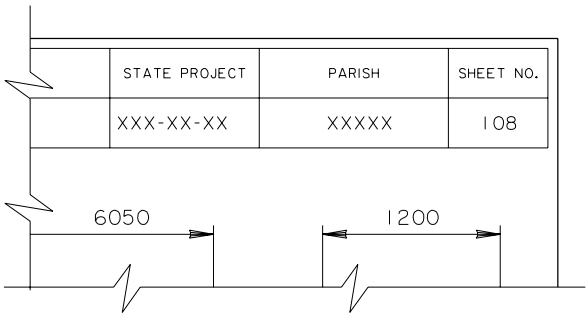


CORRECTED SHEET

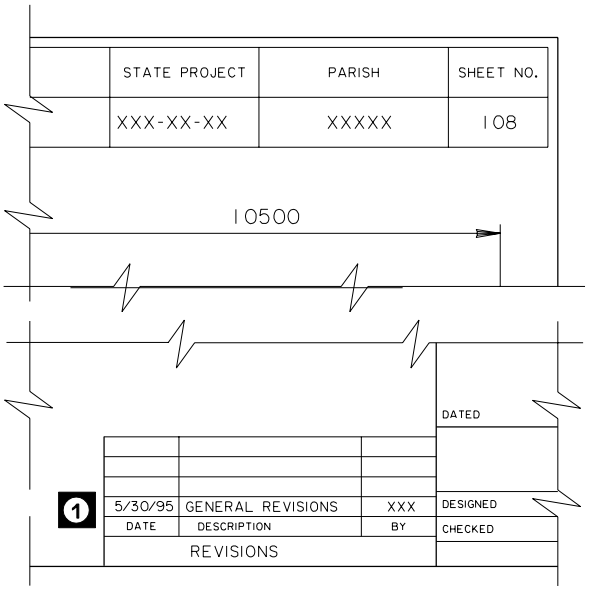


2. IF MAJOR REVISIONS ARE NEEDED, DESTROY THE ORIGINAL SHEET AND MAKE CHANGES ON THE NEW SHEET FOR EXAMPLE:

ORIGINAL SHEET



CORRECTED SHEET

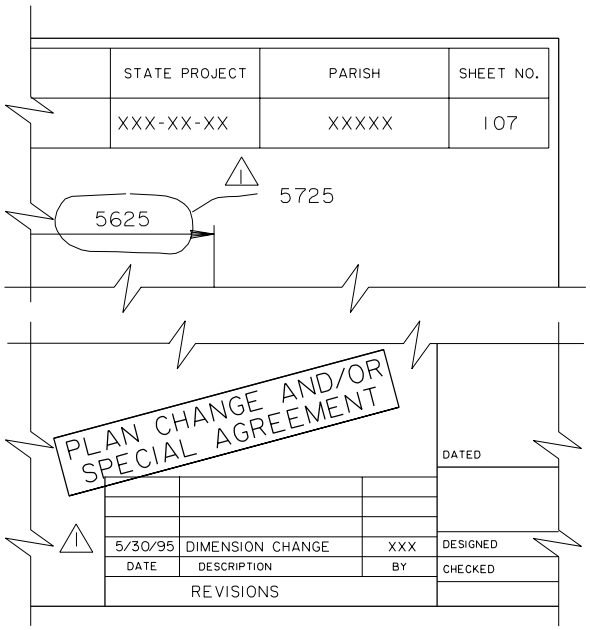


3. SHOW REVISION NUMBER (1) FOR ALL REVISED SHEET NUMBERS (INCLUDING TITLE SHEET NUMBER) IN THE TITLE SHEET REVISION BLOCK.
4. IF QUANTITIES ARE INVOLVED, REVISE COST ESTIMATE.
5. THE TITLE SHEET REVISION BLOCK MUST BE SIGNED BY THE CHIEF ENGINEER.
6. TRANSMIT A SET OF PRINTS AND A COPY OF ESTIMATE TO CONTRACTS AND SPECIFICATIONS SECTION.
7. RETURN THE REVISED PLANS TO GENERAL FILES.

REVISION PROCEDURE

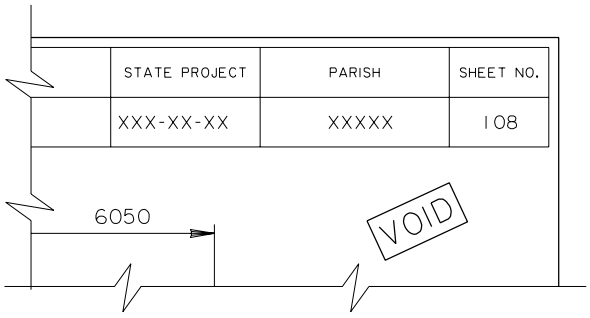
REV. 12/01/99

1. IF A MINOR PLAN CHANGE IS REQUIRED, MAKE THE CORRECTIONS ON THE ORIGINAL SHEET. (NO ERASURES!) NOTE THE CORRECTIONS WITH A"BUG" (△) AND SHOW IT IN THE REVISION BLOCK. FOR EXAMPLE:

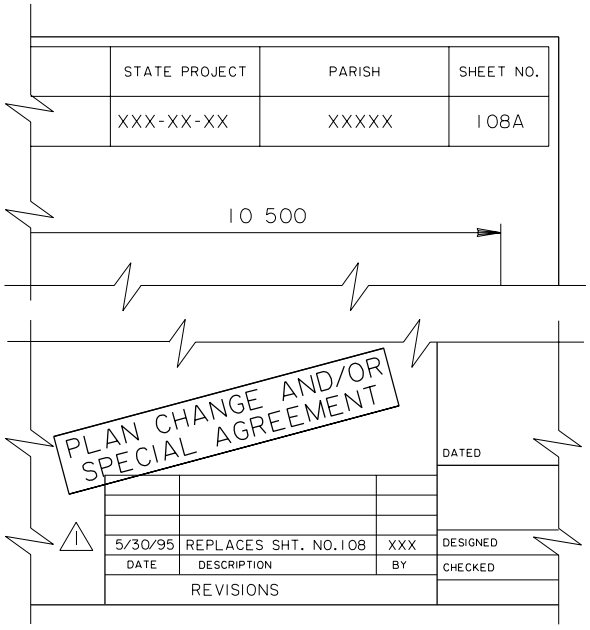


2. IF MAJOR PLAN CHANGE, MAKE CORRECTIONS ON NEW SHEET, ADD "A" TO SHEET NUMBER, AND STAMP "VOID" ON ORIGINAL SHEET. FOR EXAMPLE:

ORIGINAL SHEET



NEW SHEET



3. DON'T SHOW ANYTHING ON THE TITLE SHEET.

4. IF THE CHANGES ARE SIGNIFICANT, SHOW QUANTITY CHANGES ON BRIDGE SUMMARY SHEET.

5. TRANSMIT 18 HALF-SIZED SETS OF PRINTS OF AFFECTED SHEETS, WITH A MEMORANDUM TO THE CHIEF CONSTRUCTION ENGINEER. TRANSMIT ONE SET OF HALF-SIZED PRINTS TO THE PROJECT ENGINNER, BY COPY OF THE MEMORANDUM. IF CONSULTANTS ARE INVOLVED, SEND THEM A HALF-SIZED SET BY COPY OF THE MEMORANDUM. IF REAL ESTATE AND UTILTIES ARE INVOLVED, FULL-SIZED SETS ARE TO BE TRANSMITTED, 10 TO REAL ESTATE AND 1 TO UTILITIES, BY COPY OF MEMORANDUM.

6. RETURN PLANS TO GENERAL FILES.

PLAN CHANGE PROCEDURES

REV. 12/01/99

STOPPING SIGHT DISTANCE

GENERAL

The effects of stopping sight distance (SSD) bring a challenging aspect to the design of bridge geometrics. The SSD will impact bridge economics, right-of-way, and environmental considerations. The designer should take all factors into consideration during the early stages of plan development when selecting the design criteria for horizontal and vertical alignments.

Sight distance, the ability to see ahead adequately, is of extreme importance in a properly designed structure. SSD is the sum of the brake reaction distance and the braking distance required to stop on a wet surface for the speed in question and is a function of many variables. For each specific design speed, AASHTO has computed a range of distances required to stop when traveling at that particular speed. The upper value (desirable value) utilizes the design speed to compute the required stopping distance. The minimum values utilize the average running speed associated with the design speed.

In selecting proper horizontal and vertical geometry, the designer should first consider minimum values of SSD. Circumstances do occur where increasing the SSD above the minimum value is required. Such cases should be evaluated on a case by case basis.

VERTICAL ALIGNMENT

When a bridge is in a vertical curve, the actual roadway surface can be detriment to sight distance. The designer should begin the vertical curve length selection by providing a minimum value of SSD. If conditions exist where increased value of SSD is desirable, it will be acceptable for the designer to use vertical curves providing SSD greater than the minimum. In cases where neither minimum nor desirable values produce a practical layout, consideration should be given to lowering the design speed to something less than what the design standards have dictated. (The lowering of the design speed will require a design exception approved by the Chief Engineer.)

HORIZONTAL ALIGNMENT

When a bridge is in a horizontal curve, the barrier rail can become a sight obstruction on the inside of the curve if the shoulder does not have adequate width. For this reason, the shoulder widths specified by the design standards must be checked to verify if the minimum SSD criteria are being provided. "A Policy on Geometric Design of Highways and Streets" shows the geometry involved in determining the SSD and a table of minimum shoulder width values for various conditions is being provided herein for use in making this determination. It should be noted that the SSD requirements become more critical when a downgrade is being encountered.

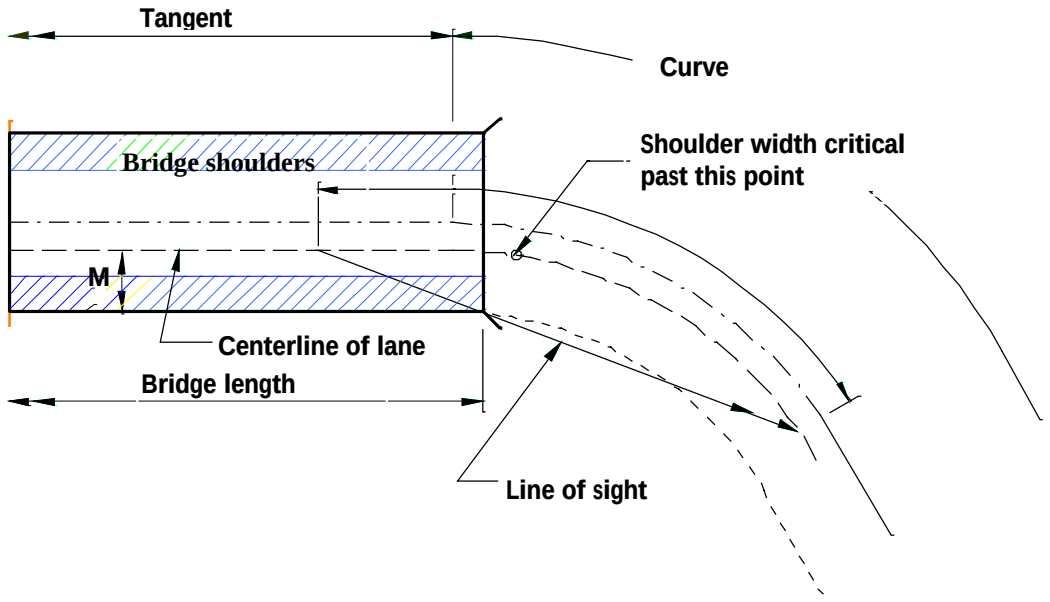
After the roadway classification has been determined, the minimum shoulder width is obtained utilizing the design standards. The sketch for determining SSD and/or the table of shoulder widths (See this Section) can be used to verify if the requirements of SSD are met. If only a short section of the bridge falls within the horizontal curve, sight distance may not be a problem and can be determined by a graphical representation. If the shoulder width obtained from the design standard does not provide minimum SSD; the designer should;

1. First consider widening the inside shoulder (shoulder widths should not exceed 3.6 m). For collector and local roads and streets, see the design standards for instructions for lowering the design speed for certain roadway classifications that will not require a design exception.

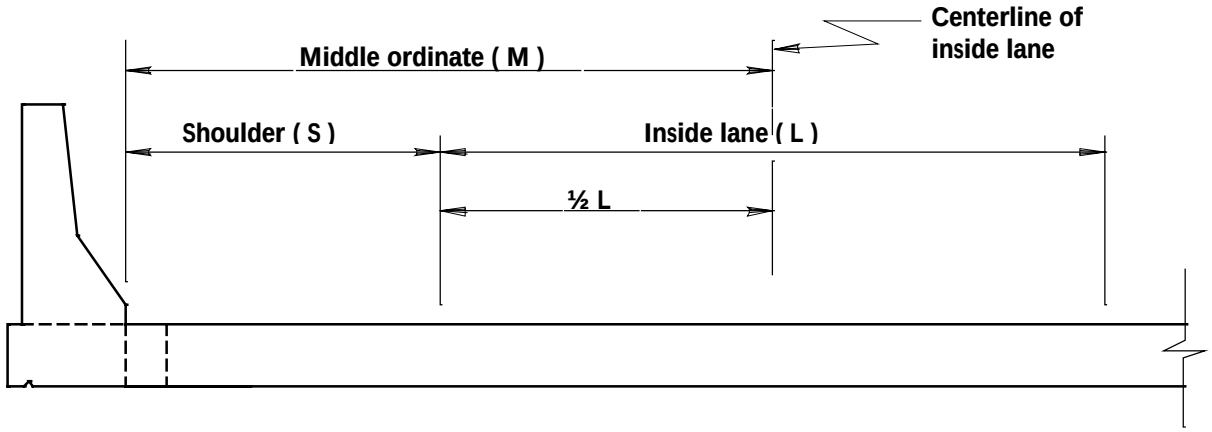
2. If the required shoulder to meet adequate SSD exceeds 3.6 m, the engineer should consider realigning the project to increase the horizontal curve radius.

3. If realignment is not a feasible alternative, the designer should consider reducing the design speed from that dictated by the design standards. This will require a design exception approved by the Chief Engineer. (If the project is a complete improvement to a section of roadway or if it has a high probability of being improved by a future project, or the route has a high ADT, a reduction in the design speed should be considered only as a last resort.)

BRIDGE RAILING EFFECTS ON HORIZONTAL SIGHT DISTANCE



PLAN VIEW



ELEVATION VIEW

M = Minimum distance to meet stopping sight distance requirements. (See Table)
L = Width of travel lane.
S = Shoulder Width required for SSD = M - ½ L $\geq$ Minimum Design Standard
$\leq$ 3.6 m (in no case shall shoulder width exceed 3.6 m)

HORIZONTAL SIGHT DISTANCE CHART

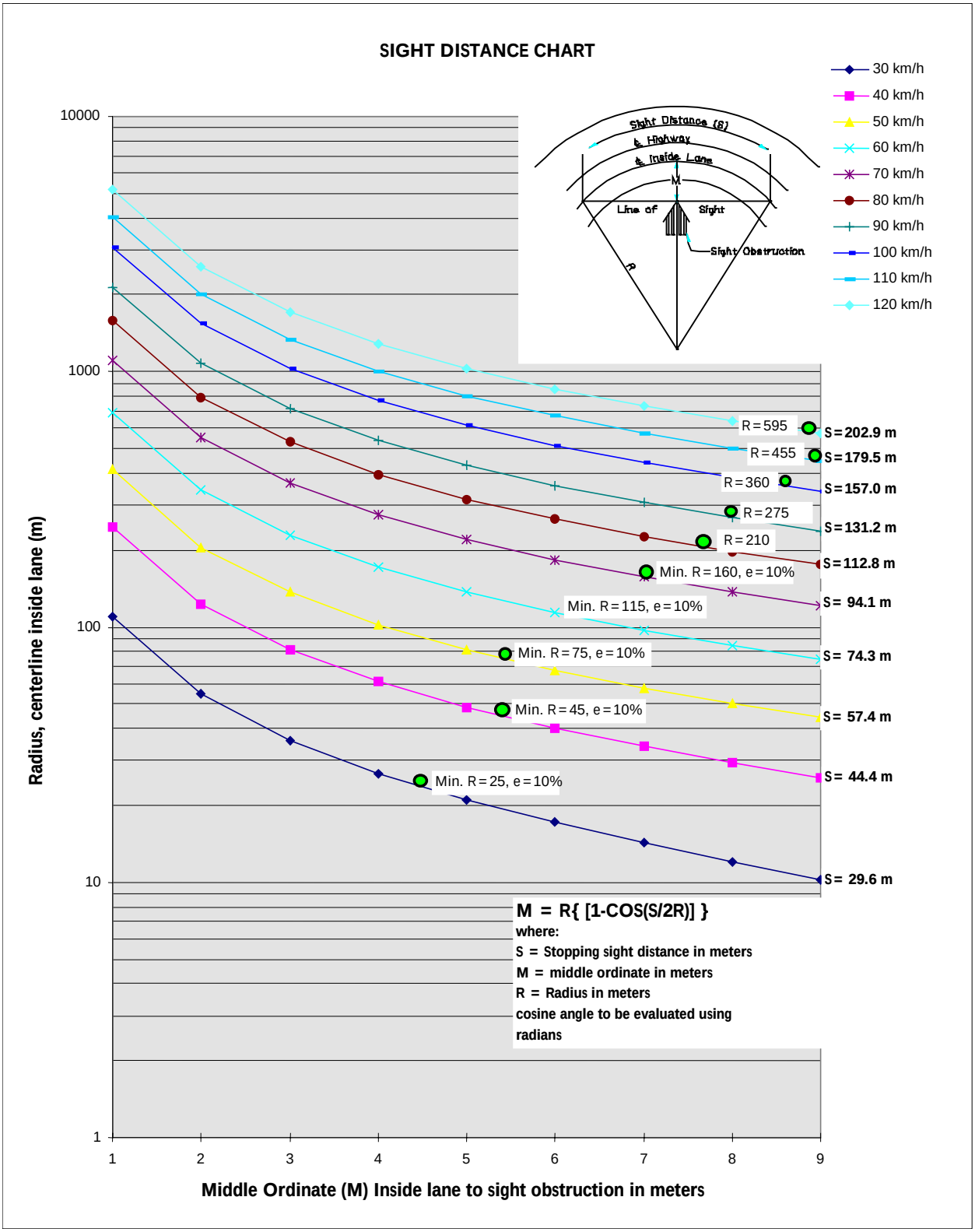


TABLE OF "M" VALUES IN METERS

VELOCITY	50 km/hr			70 km/hr			80 km/hr			100 km/hr			120 km/hr		
SSD(m)	57.4	65.5	68.6	94.1	117.5	125.8	112.8	148.8	160.5	157.0	220.8	240.6	202.9	310.1	341.0
GRADE (%)	0.0	-3.0	-6.0	0.0	-3.0	-6.0	0.0	-3.0	-6.0	0.0	-3.0	-6.0	0.0	-3.0	-6.0
RADIUS(m)															
20.00															
40.00															
60.00															
80.00	5.09														
100.00	4.08	5.31													
120.00	3.41	4.44	4.86												
140.00	2.93	3.81	4.18												
160.00	2.56	3.34	3.66												
180.00	2.28	2.97	3.25												
200.00	2.05	2.67	2.93												
220.00	1.87	2.43	2.66	5.01											
240.00		2.23	2.44	4.59											
260.00		2.06	2.26	4.24											
280.00		1.91	2.10	3.94											
300.00			1.96	3.68			5.28								
320.00			1.83	3.45	5.37		4.95								
340.00				3.25	5.06		4.66								
360.00				3.07	4.78		4.40								
380.00				2.91	4.53	5.19	4.17								
400.00				2.76	4.30	4.93	3.96								
420.00				2.63	4.10	4.69	3.78								
440.00				2.51	3.91	4.48	3.60								
460.00				2.40	3.74	4.29	3.45								
480.00				2.30	3.59	4.11	3.31								
500.00				2.21	3.44	3.95	3.17								
520.00				2.12	3.31	3.79	3.05	5.31							
540.00				2.05	3.19	3.65	2.94	5.11							
560.00				1.97	3.07	3.52	2.83	4.93							
580.00				1.90	2.97	3.40	2.74	4.76		5.30					
600.00				1.84	2.87	3.29	2.65	4.60	5.35	5.12					
620.00					2.78	3.18	2.56	4.45	5.18	4.96					
640.00					2.69	3.08	2.48	4.31	5.02	4.80					
660.00					2.61	2.99	2.41	4.18	4.87	4.66					
680.00					2.53	2.90	2.33	4.06	4.72	4.52					
700.00					2.46	2.82	2.27	3.94	4.59	4.39					
720.00					2.39	2.74	2.20	3.84	4.46	4.27					
740.00					2.33	2.67	2.15	3.73	4.34	4.15					
760.00					2.27	2.60	2.09	3.63	4.23	4.04					
780.00					2.21	2.53	2.04	3.54	4.12	3.94					
800.00					2.15	2.47	1.98	3.45	4.02	3.84					
820.00					2.10	2.41	1.94	3.37	3.92	3.75					
840.00					2.05	2.35	1.89	3.29	3.83	3.66					
860.00					2.00	2.30	1.85	3.21	3.74	3.58					
880.00					1.96	2.24	1.80	3.14	3.65	3.49					
900.00					1.91	2.19		3.07	3.57	3.42					
920.00					1.87	2.15		3.00	3.49	3.34					
940.00					1.83	2.10		2.94	3.42	3.27					
960.00						2.06		2.88	3.35	3.20			5.35		
980.00						2.02		2.82	3.28	3.14			5.24		
1000.00						1.97		2.76	3.21	3.08			5.13		
1500.00								1.84	2.14	2.05	4.06	4.81	3.42		
2000.00											3.04	3.61	2.57		
2500.00											2.43	2.89	2.06	4.80	
3000.00											2.03	2.41		4.00	

*TABLE OF M VALUES BASED ON MINIMUM VALUES OF STOPPING SIGHT DISTANCE IN WET CONDITIONS.
RADIUS = THE RADIUS TO CENTERLINE OF INSIDE LANE

NORMAL HIGHWAY CLEARANCES

STRUCTURES

Vertical Clearance

Freeways and Arterials	**5.05 m** (min.)[2]
Truss Portals	**5.35 m** (min.)[2]
Pedestrian Bridge	**6.00 m** (Desirable)[2] **5.35 m** (min.)[2]
All other roads and streets	**4.75 m** (min.)[2]

Horizontal Clearance

All roadways[3]

OVERHEAD SIGNS[4]

Vertical Clearance

From high point of pavement to bottom of sign face	**5.5 m** (min.)[2]
From high point of pavement to bottom of lighting or other appurtenances	**5.2 m** (min.)[2]

Horizontal Clearance

From edge of roadway (with flat shoulders)[3]
From edge of curbed roadways **0.6 m** (min) behind the curb

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[2] Includes 150 mm for future overlays
[3] See G.R.-200(M) Standard Plans to determine clear zones. In general, guardrail or crash protection shall BE provided where horizontal clearances are less than the minimum.
[4] For additional information see AASHTO "Roadside Design Guide", the current MUTCD, and the "Louisiana Manual on Uniform Traffic Control Devices".

SHOULDER MOUNTED SIGNS[4]

Vertical Clearance (Freeways)

(above the pavement edge)

Guide signs	**2.1 m** (min.)
Guide signs with secondary signs mounted below	**2.4 m** (min.)
Route markers, warning	**1.8 m** (min.)
Regulatory signs	**1.5 m** (min.), rural **2.1 m** (min.), urban

Horizontal Clearance

Freeway from roadway edge[3]

All other roadways:

from edge of roadway	**3.1 m** (min.)[5]
from edge of curb	**0.6 m** (min.)[5]

LIGHT STANDARDS

Vertical

Above pavement	**9.1 m** (min.)

Horizontal Clearance

From edge of traveled roadway	**4.5 m** (min.)[5]
From edge of ramps	**3.1 m** (min.)[5]

[5] Breakway design assumed

RIGHT-OF-WAY FOR BRIDGES

The following general guidelines should be considered when setting right-of-way for bridges:

The right-of-way clearance shown in the design standards shall be generally applicable for the bridges, as well as the roadways, with the additional restrictions noted herein.

1. The required right-of-way line should clear the toe of the embankment slope a minimum of 1.5 m to 3 m.

2. A minimum dimension of 7.5 m should generally be provided from the outside face of the structure to the required right-of-way line.

3. Construction servitude must be provided for detour bridges.

4. It should be recognized that while it is desirable to follow the above guidelines, there are certain situations which demand exceptions. For example, in congested urban areas, the right-of-way costs are often prohibitive and required right-of-way should be kept to a minimum.

For additional information and the Department's right-of-way policy, see the "Engineering and Directives Manual", EDSM No.II.1.1.1 .

BRIDGE AESTHETICS

The purpose of this article is to suggest design guidelines concerning bridge details which affect the aesthetic appearance of bridge structures.

There are numerous conventional considerations, such as cost estimates and geometric requirements, necessary in arriving at an economical and efficient design for any particular bridge structure in a given location. However, there is another requirement that should be considered. Specifically it is the appearance of the completed structure. Generally, structural efficiency does not include the good appearance of the individual structural element, but attention to the details as to how the overall structure fits together is also an important aspect to a completed structure in order to be visually pleasing.

BRIDGE DETAILS

1. The centerline of exterior girders shall be aligned with exterior girders in adjacent spans.

2. Short bridges used for grade separation will have flanking spans, adjacent to the fill, of a length not less than one half the length of the main interior span(s). The exterior girders should be the same depths throughout, if possible.

3. In areas where spans can be observed by passing motorists, businesses and/or residences on adjacent properties, attention should be paid to surface finishes on the exposed concrete surfaces of substructures and superstructures.

4. Gutter drains should be omitted from overpasses where staining presents a problem.

5. The number of columns used in column bents should be kept to a minimum.

6. The exterior columns of column bents and the exterior piles of pile bents shall be aligned with the column/piles of adjacent bents where practical.

7. In urban areas, consideration should be given to placing cover walls at ends of bent caps to hide joint openings, anchor bolts and risers normally seen in the elevation view.

8. When weathering steel is to be used, special considerations should be given to keep runoff from staining the substructure.

CONSTRUCTION SIGNING AND PHASING

The maintenance of traffic during construction of a project is an important aspect of design. It is incumbent on the designer to take all precautions necessary to provide for the most efficient flow of traffic. This is normally accomplished in one of four ways:

1. Detours

2. Lane Closure

3. Road closure

4. Split-Slab Construction

Detours are the most common means of maintaining traffic. Lane closures are often associated with repair projects. A road closure may be used if the route primarily serves local traffic, or if an alternate state route can be used as a detour. A pre-design questionnaire that is to be submitted to the district will normally provide adequate information to determine how traffic will be maintained. Split-slab construction is often used for bridge widening projects, where traffic is alternately maintained between sections of the new and existing bridge.

In some instances, specifications must be written to provide for traffic and construction needs. Under certain conditions, it may be necessary to require the contractor to work 24 hours shifts or to place an incentive clause in the contract to minimize disruption to traffic. Flagmen may be required and/or provisions to halt the traffic at certain periods during construction may be specified by the contract. Temporary precast barriers may be required to divert traffic for repair or widening projects. In many instances, these barrier sections are stored in the various districts, and specifications for hauling, erecting and returning the temporary barriers may be required as part of the contract. These conditions are only a few that may require written specifications.

The plan-in-hand affords a good opportunity for discussing traffic provisions, as district personnel are often better informed of traffic patterns under their jurisdiction. During the final plan phase of a project, The Traffic and Planning Section should be consulted to discuss strategies and requirements for the construction-signing layout.

For routine projects, the construction signing/phasing layout may involve only a line diagram. In the case of widening or repair projects, a more extensive layout along with explanatory notes for each traffic phase are normally included. This is especially true in the case of complicated interchanges where different ramps must be alternately closed and opened to traffic. Sometimes the construction-signing layout is superimposed on an aerial photograph. Once the "blank" layout is completed, it is then sent to the Traffic and Planning Section who adds the construction signing.

EXAMPLE OF TRAFFIC SIGNAL CALCULATIONS

Calculations to determine if phased (split-slab) construction using traffic signals is a possible option for traffic control.

Demand:

ADT = 3500 (site specific)

Peak Hourly Volume = assume 15 % of ADT
= 3500 × 0.15
= 525 VPH

ADT is generally given as averaged two-way traffic, so adjust for maximum one-way

Directional split = assume 80 / 20 split during commute hours

Peak one way traffic = 525 VPH × 0.8
= 420 VPH $_{\text{one-way}}$

Maximum traffic signal cycle length is about 100 seconds

Arrivals: 80% split = 420 VPH $_{\text{one-way}}$ × 1 hour ÷ 3600 sec × 100 sec/cycle
= 11.7
≈12 vehicles per cycle

Arrivals: 20% split = 3500× 0.15× 0.20 ×100 ÷3600
= 2.9
≈ 3 vehicles per cycle

Capacity:

Operating Speed V_{OS} = assume 30 MPH = 44 ft/sec (site specific)

Minimum safe vehicle spacing at operating speed = 1.50 × 20 feet ÷ V_{OS} = 1.96
≈ 2 seconds per vehicle

Length closed between signals = bridge length + [approach slabs + taper for barriers]
= 650'+ [40' + 60'] × 2
= 850'

Time to travel closed length = 850'÷ 44 ft/sec
= 19.3
≈ 20 seconds

Assume 100 second cycle with a 60 / 40 phase split, determine available vehicle travel time

	60% phase	40% phase
green time	100 x 0.60 = 60.0 sec	100 x 0.40 = 40.0 sec
lost time (start-up)	= -3.5 sec	= -3.5 sec
effective green	56.5 sec	36.5 sec
time to travel closed length	-20.0 sec	-20.0 sec
available vehicle travel time	36.5 sec	16.5 sec

VPC_{60} = vehicles per cycle [60%]
= 36.5 sec per cycle ÷ 2 sec per vehicle
= 18.25 vehicles per cycle
≈ **18 (capacity)** ≥ 12 (demand)

VPC_{40} = vehicles per cycle [40%]
= 16.5 sec per cycle ÷ 2 sec per vehicle
= 8.25 vehicles per cycle
≈ **8 (capacity)** ≥ 3 (demand)

DETOUR BRIDGES AND ROADWAYS

Detour bridge details shall be in accordance with the standard bridge detour details

BRIDGE DETOUR TYPE OPTIONS

At the contractors option, the detour bridge may be one of the following:

1. LA DOTD detour bridge metric standard details.

2. Other approved alternatives: The contractor will be required to submit drawings and calculations for this alternate to the bridge design engineer for approval. These drawings and calculations shall be stamped by a civil engineer registered in the State of Louisiana. The alternate shall be designed according to the latest AASHTO standard specifications for highway bridges. design live load shall be MS-18 and HST-18 (M). all drawings shall be submitted according to section 801 of the Louisiana Standard Specifications For Roads And Bridges to be approved by the bridge design engineer.

3. Acrow prefabricated steel panel bridge: The use of this bridge type must be approved for use by the bridge design engineer. If approved, the department will provide the contractor with the superstructure and substructure details for the bridge(s).

SUBSTRUCTURE OPTIONS

1. Bent caps will be precast concrete. Piles may be timber or steel.

2. Pile lengths: The contractor shall be responsible for determining the pile lengths. A factor of safety of 2.0 will be used in determining the pile lengths. Calculations stamped by a civil engineer registered in the state of Louisiana to justify the pile lengths will be sent to the bridge design engineer for approval

GUARDRAILS

Guardrails shall be installed at all four (4) corners of detour bridges with a minimum length of 19.05 m for bridges having flexible rail, concrete or barrier types. All guardrails for detour bridges shall be included in the price for "Temporary Detour Bridging". For details, see DOTD Bridge Detour Standard Details.

LOCATION OF DETOUR, PLAN AND PROFILE DETAILS, AND FINISH GRADE

The determination of the detour location should be made on the plan-in-hand inspection or at the subsequent office review. The detour details shall include a plan and profile of the bridge indicating the finish grade, span types and lengths, natural ground line, substructure types, and any geometric information needed.

The length and finish grade of the detour bridge shall be determined using a flood frequency equal to the detour service life multiplied by the drainage design factor (DDF).

Flood Frequency = Service Life x DDF (Service Life $\geq$ 1 year)

DDF = 3 (ADT $\leq$ 750)

= 5 (ADT > 750)

= 7 (4-lane crossover)

A discharge and high water elevation is then computed for the detour flood frequency. The finish grade of the detour bridge should be set approximately 1 m above the detour high water, and the length should be set as required to pass the detour discharge, Q. In many instances (particularly in North Louisiana) the requirements of spanning bank to bank will govern over the hydraulics. Bulkheads will be used as per our detour bridge standard detail. A profile of the natural ground should be drawn as an aid in establishing the detour profile. The profile can then be superimposed on the ground line in order that the fill/cut areas may be balanced as much as possible. Profile grades should not exceed 5%. Slope stability of the embankments must be a consideration when determining the length of the detour bridge. The Geotechnical Section should review the detour embankments when deemed necessary and provide comments concerning slope stability.

When placing a detour over deep ravines, pile slenderness ratios (L/D) must be considered.

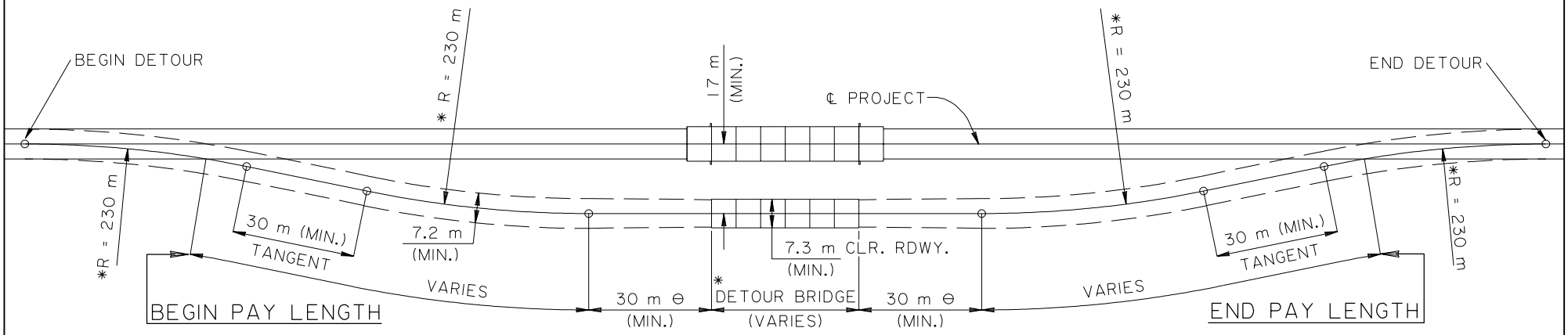
DETOUR LAYOUT SHEET

Detour layout will be set up in accordance with the following guidelines:

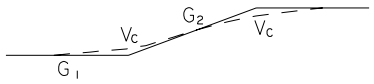
1. Detour stations will be relative to the survey centerline and shown at the beginning and the end of detour. Other stations along the detour shall be shown as projected stations off the centerline.

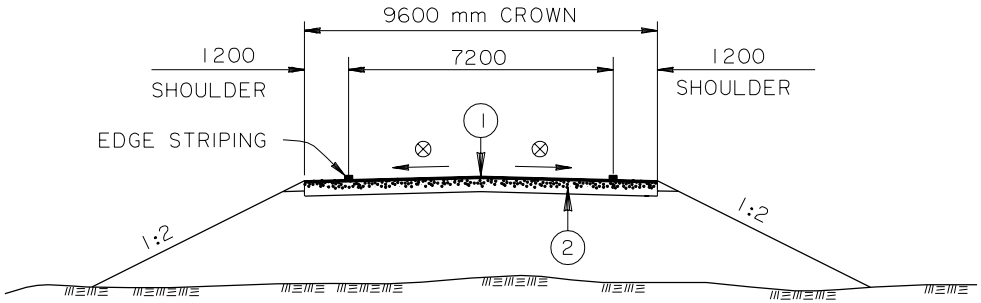
2. The profile shown shall represent the true profile along the detour alignment. Since the lengths shown along the profile will not add up to the difference in stations at the beginning and the end of detour, the following note should be added for clarification:

   NOTE: LENGTHS ARE MEASURED ALONG DETOUR CENTERLINE AND STATIONS ARE PROJECT CENTERLINE STATIONS.



PLAN





TYPICAL ROADWAY SECTION

* SEE DETOUR BRIDGE METRIC STANDARD DETAILS.

⊖ WHERE APPROACH ROADWAY IS WIDER THAN THE BRIDGE, ROADWAY WILL BE TRANSITIONED IN THIS AREA TO MATCH BRIDGE WIDTH.

LIMITS:
- K = 21.5
- G_1 or G_2 max = 7%
- A = $G_1 + G_2$
- VC_{min} = KA = 21.5 (.07+ 0) 100 = 150 m

(1) △ 80 mm ASHALTIC CONCRETE (TYPE 9 WEARING COURSE)

(2) △ 220 mm CLASS II BASE COURSE

⊗ 2.5% SLOPE (NOTE: FOR CURVES ADJACENT TO DETOUR STRUCTURE, THE PROJECT ENGINEER MAY SUPERELEVATE WITH A MAXIMUM RATE OF 4%)

* R = 185 m ALLOWED IN URBAN AREAS

NOTE:

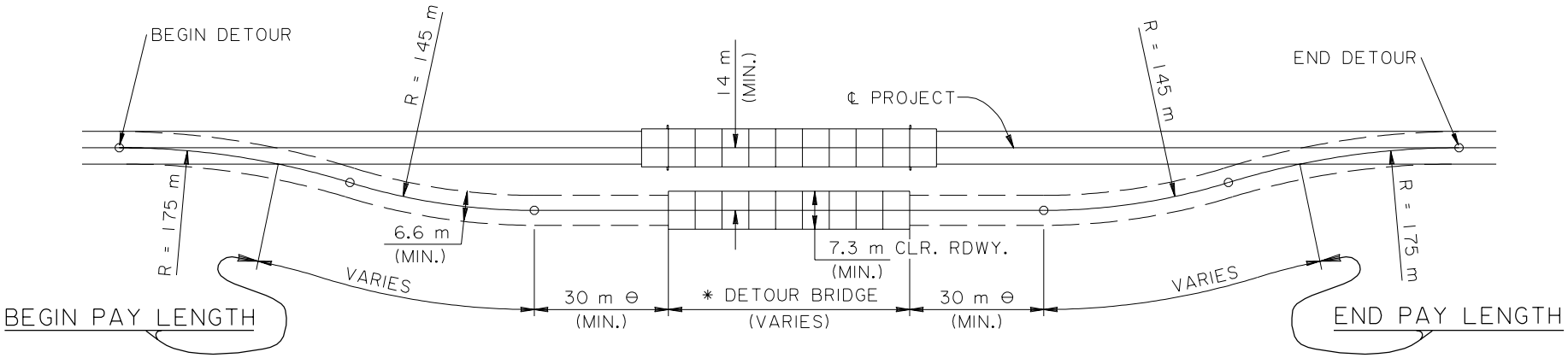
DETAILS SHOWN INDICATE THE MINIMUM DETOUR SURFACING REQUIREMENTS. SUBJECT TO THE APPROVAL OF THE PROJECT ENGINEER, THE CONTRACTOR MAY USE OTHER SURFACING AND BASE MATERIAL EQUAL TO OR SUPERIOR TO THOSE SHOWN IN THE PROJECT PLANS.

DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED.

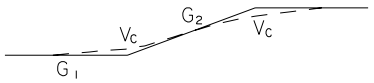
TYPE "I" DETOUR

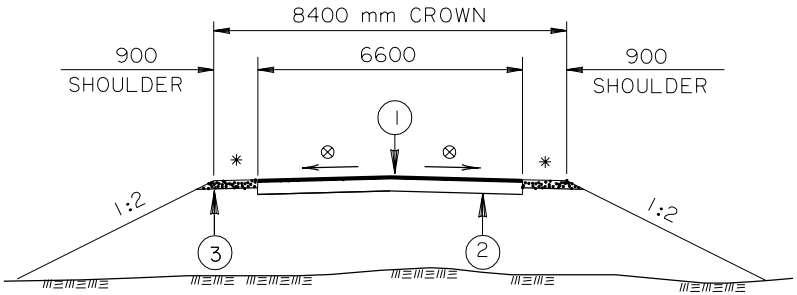
OVER 750 ADT
(60 Km/h)

Rev. 04/01/99



PLAN





TYPICAL ROADWAY SECTION

* SEE DETOUR BRIDGE METRIC STANDARD DETAILS.

Θ WHERE APPROACH ROADWAY IS WIDER THAN THE BRIDGE, ROADWAY WILL BE TRANSITIONED IN THIS AREA TO MATCH BRIDGE WIDTH.

LIMITS:

$K = 12$

G_1 or G_2 max = 7%

$A = G_1 + G_2$

$VC_{min} = KA = 12\ (.07 + 0)\ 100 = 84$ m

(1) △ 50 mm ASHALTIC CONCRETE (TYPE 9 WEARING COURSE)

(2) △ 220 mm CLASS II BASE COURSE

⊗ 2.5% SLOPE (NOTE: FOR CURVES ADJACENT TO DETOUR STRUCTURE, THE PROJECT ENGINEER MAY SUPERELEVATE WITH A MAXIMUM RATE OF 2.5%)

* 5% SLOPE

(3) 100 mm AGGREGATE SURFACE COURSE

△ AGGREGATE SURFACING MAY BE USED AT THE DISCRETION OF THE PLAN-IN-HAND PARTY. IN NO CASE SHALL A HARD SURFACED DETOUR BE USED FOR MAINTAINING TRAFFIC ON AN EXISTING AGGREGATE SURFACED ROAD.

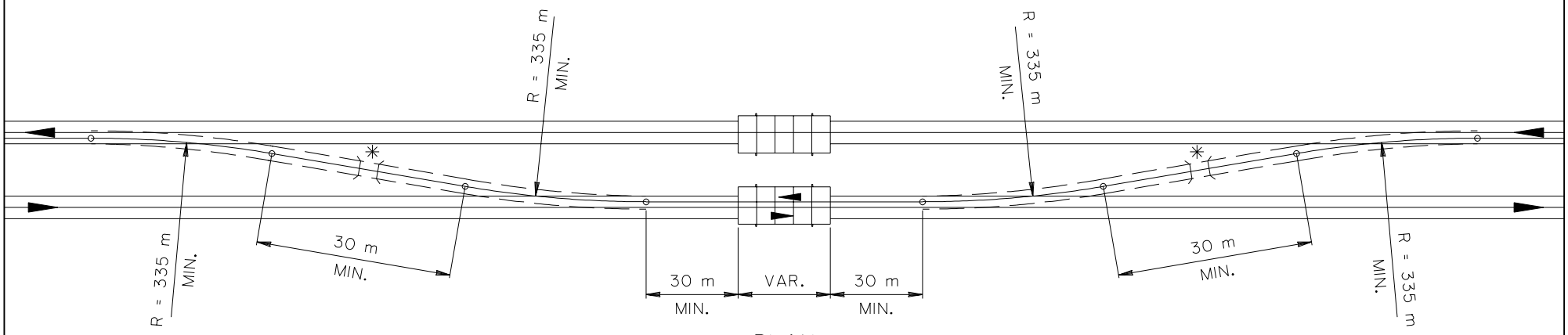
NOTE:

DETAILS SHOWN INDICATE THE MINIMUM DETOUR. SURFACING REQUIREMENTS ARE SUBJECT TO THE APPROVAL OF THE PROJECT ENGINEER. THE CONTRACTOR MAY USE OTHER SURFACING AND BASE MATERIAL EQUAL TO OR SUPERIOR TO THOSE SHOWN IN THE PROJECT PLANS.

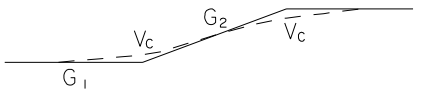
TYPE "2" DETOUR

UNDER 750 ADT
(50 km/h)

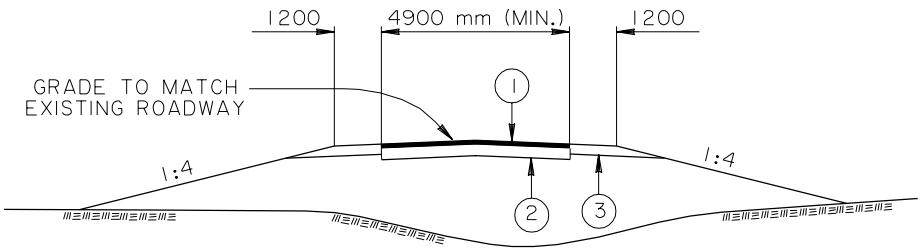
Rev. 04/01/99



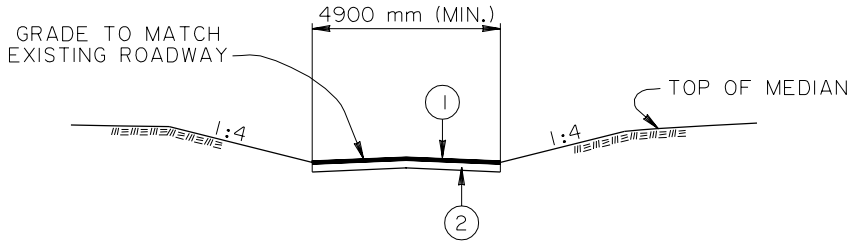
PLAN



LIMITS: K = 25
G_1 or G_2 max = 7%
A = $G_1 + G_2$
VC_{min} = KA = 25 (.07+ 0) 100 = 175 m



TYPICAL ROADWAY SECTION
DEPRESSED MEDIAN



TYPICAL ROADWAY SECTION
RAISED MEDIAN

* TEMP DRAINAGE DITCH, PIPE SIZE & LOCATION TO BE DETERMINED IN FIELD

NOTE:

DETAILS SHOWN INDICATE THE MINIMUM DETOUR SURFACING REQUIREMENTS. SUBJECT TO THE APPROVAL OF THE PROJECT ENGINEER, THE CONTRACTOR MAY USE OTHER SURFACING AND BASE MATERIAL EQUAL TO OR SUPERIOR TO THOSE SHOWN IN THE PROJECT PLANS.

(1) 100 mm ASHALTIC CONCRETE (50 mm WEARING COURSE)(50 mm BINDER COURSE) (TYPE 9)

(2) 220 mm TYPE II BASE COURSE

(3) 100 mm AGGREGATE SURFACE COURSE

TYPE "3" DETOUR

TYPICAL CROSSOVER DETOUR FOUR-LANE HIGHWAY (70 km/h)

Rev. 04/01/99

SPECIAL LOADING CONSIDERATIONS

DEAD LOAD

The dead loads shall be distributed as specified in the AASHTO Specifications except as follows: railings, parapets, and sidewalks shall normally be assumed to be carried by the exterior girder only. If in the judgment of the design engineer, the dead load of the sidewalk parapet is cantilevered "excessively" out from the exterior girder, he may sum moments due to dead load components supported by the exterior girder about the first interior girder. A load of 600 N/m² shall be applied to the deck to account for future wearing surface.

EARTHQUAKE LOADING

Earthquake loading shall be investigated in accordance with the "AASHTO Guide Specifications for Seismic Design of Highway Bridges". (See Chapter 6)

LIVE LOAD

Stresses

Live load stresses shall be determined as specified in the AASHTO Specifications except as follows: for moments, shears and reactions, the design load shall be AASHTO MS-18 truck or lane load, or Louisiana HST-18(M) truck load, whichever governs, except that for local (farm-to-market) roads HST-18(M) loading shall generally not be used. When lane loading is used, it shall be distributed as equivalent concentrated wheel loads.

Serviceability

For fatigue serviceability requirements and deflection considerations, HST-18(M) loading shall not be used. Live load deflection shall be computed in accordance with the AASHTO Specifications except that the number of loaded lanes shall equal to the number of actual travel lanes.

Military Loading

Alternate military loading shall be applied on the interstate system for the design of main bridge members. Transversely reinforced concrete slabs which are supported by main longitudinal members are not considered as main load carrying members. Military loading shall be as specified in the AASHTO Specifications with the following modifications: The standard MS-18 loading has been supplemented by the addition of a tandem axle modified loading consisting of 108 kN on each of two (2) axles, spaced 1200 mm apart as shown herein. Military loading is only required on interstate bridges.

Impact

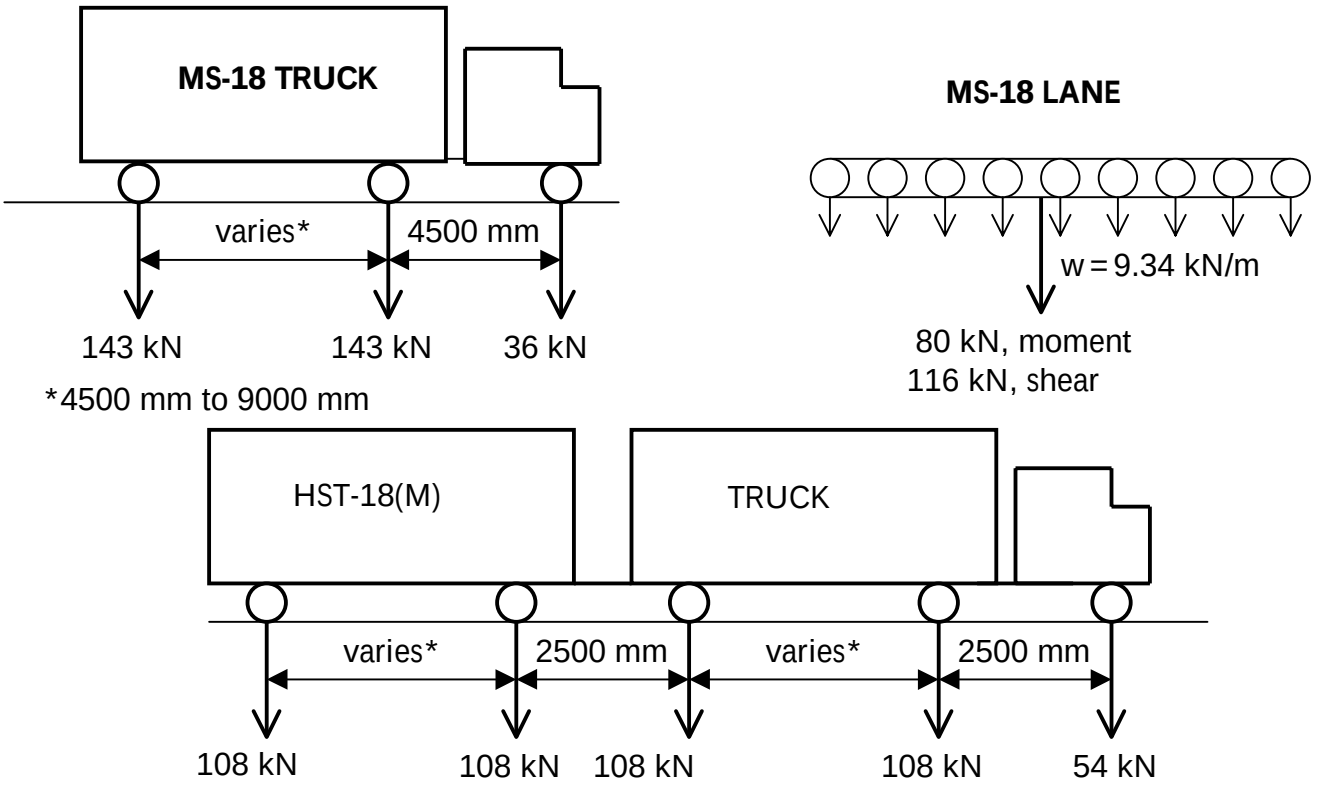
Impact shall be applied as specified in the AASHTO Specifications except as follows: impact shall be applied to caps of pile bents and to all portions of column bents except piles.

Summary Of Live Loads

TRUCK TYPE	WHERE USED	SPECIAL CONSIDERATIONS
MS-18	All bridges	Truck or lane[6], whichever governs
HST-18(M)	All bridges except on local (farm to market) roads	Not used for serviceability requirements, fatigue or camber calculations
MILITARY	Interstate bridges only	Generally governs only for spans < 9.15 m

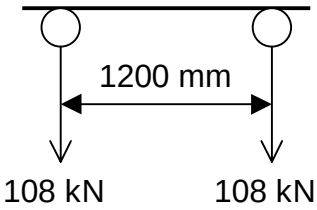
Longitudinal View of Loading

Axle Load shown, wheel load = ½ axle load

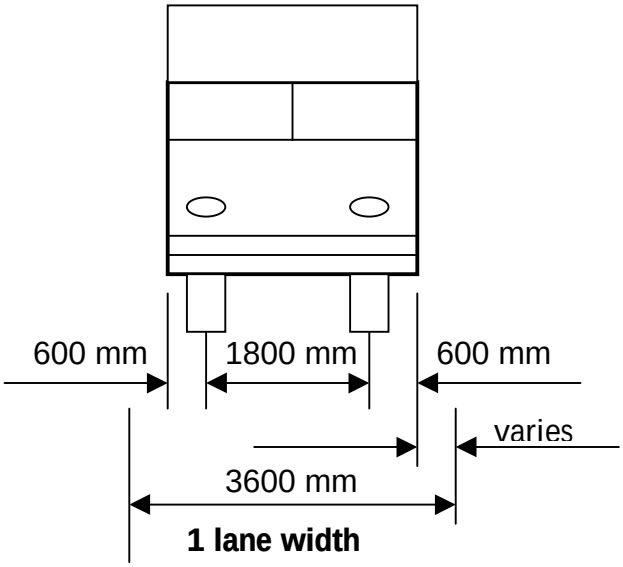


[6] Additional concentrated load requirements for continuous spans, see AASHTO Specifications

Military Loading



Transverse View of Loading



Sound Wall Load:

Bridges which require installation of Sound Walls shall be designed to accommodate the appropriate dead, live and wind loads for the required wall height. Dead loads of the wall shall be minimum of 45 kg/m for wall heights up to 3 meters and 90 kg/m for walls greater than 3 meters.

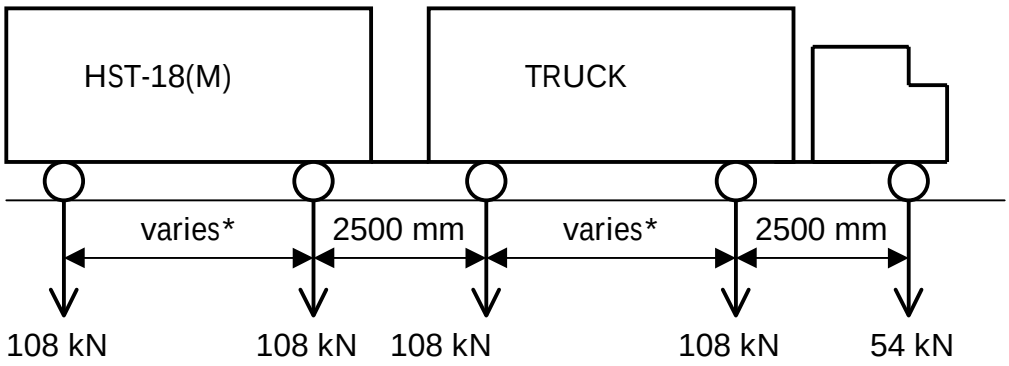
SUMMARY OF GENERAL NOTES COMMONLY USED IN BRIDGE PLANS

GENERAL ITEMS

1. Design Specifications: Structural design is in accordance with AASTHO Standard Specifications for Highway Bridges, 1996, and interim specifications. Geometric Design is in accordance with " A Policy on Geometric Design of Highway and Streets, 1994".

2. Design Criteria: The bridge is designed for a future wearing surface equal to 600 N/m².

3. Live Loading: MS-18 truck or lane load, or HST-18(M) truck load, whichever governs. HST-18(M) shall not be used for fatigue criteria or for service load requirements for steel members designed by the load factor method. (Add military loading for interstate routes.)



*4500 mm to 9000 mm

4. Design speed: km/h.

5. Construction Specifications: Construction shall be in accordance with the Louisiana Department of Transportation and Development Standard Specifications for Roads and Bridges, 1992, except as supplemented or amended by the plans, Supplemental Specifications and/or Special Provisions

6. Elevations: All elevations are based on N.A.V.D.- 88[7]

7. Dimensions: All dimensions are given at normal temperature of 20 degrees Celsius.

8. Year Plate: Date of construction is required at right wingwalls of structures for oncoming traffic lanes. (See standard detail YP-01(M)).

[7] In most cases, the survey datum is based on N.A.V.D.-88, however the Engineer is responsible to check the level books for datum reference used prior to placing this sentence in the plans.

9. All areas of disturbed embankment slopes not having revetment are to receive seeding and fertilizing (no direct pay).

CONCRETE ITEMS

All superstructure concrete is to be Class "AA" concrete, all substructure concrete is to be Class "A", all precast prestressed concrete members are to be Class "P" or "P(M)" concrete unless otherwise specified in the plans. Chamfer all exposed edges of concrete 20 mm except all corners of bents which shall be chamfered 40 mm unless otherwise noted. No deductions are to be made in concrete quantities for chamfers 40 mm or less. Concrete and steel in concrete railing to be paid for per linear meter of concrete railing including No. 15 bars that project into railing.

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Concrete Construction Joint Notes

A. Construction Joints: Where construction joints are used, not less than seven (7) days shall have elapsed between adjacent pours. The vertical surfaces of the construction joints between adjacent pours shall be coated prior to each succeeding pour with a type II epoxy resin system in accordance with subsection 805.06(B)(2) of the Standard Specifications. Epoxy is to be applied in accordance with the manufacturer's instructions. No direct payment for this work.

B. Concrete Bonding: Where new concrete is to be bonded to existing concrete surfaces, the contractor shall coat the existing concrete surface with a type II epoxy resin system in accordance with subsection 805.06(B)(2) of the Standard Specifications prior to placing of new concrete, (no direct payment). After pouring the entire deck, a minimum of three (3) days must elapse (or concrete shall attain a minimum compressive strength of 11 MPa before placement of reinforcing steel and forms for barrier railing. The slab shall attain a minimum compressive strength of 24 MPa before pouring the barrier railing.

Concrete Repair Notes

A. Concrete Removal: Existing concrete to be removed shall be designated in the plans. Where concrete is designated to be removed, a 20 mm deep saw cut shall be made along the face of the concrete around the perimeter of the removal area. All existing concrete removed from the bridge shall become the property of the contractor and shall be disposed of outside the limits of the right-of -way.

B. Epoxy Application: An approved epoxy resin system in accordance with QPL-32, shall be used to bond the new concrete to the existing concrete. Epoxy shall be applied in accordance with the manufacturer's instructions.

C. Reinforcing Steel Repairs: Existing reinforcing steel to remain shall project from the concrete surface the minimum distance shown in the plans. This steel shall be straightened and cleaned of old concrete and foreign material before the new concrete is poured. Care shall be taken to insure that the existing reinforcing steel is not broken during concrete removal, straightening or cleaning. In the event that any projecting steel is broken, it must be repaired either by welding an equivalent sized bar in accordance with AWS D 1.4-92 or by using an approved mechanical splice in accordance with QPL-44.

D. Deck Patching: This item consists of removing and replacing areas of existing bridge deck where delaminations have occurred in accordance with the standard specifications and the following requirements:

Areas requiring patching shall be determined by sounding the deck with hammers or chains as directed by the engineer. Unsound concrete shall be removed to a minimum depth of 65 mm below the surface. All reinforcing bars and exposed surfaces of concrete shall be thoroughly cleaned by sandblasting prior to placement of patching material. Feather edges shall be eliminated by saw cutting sound concrete to a vertical surface 15 mm deep around the patch. Care shall be taken to prevent damaging any exposed reinforcing steel.

Patching shall be made with a rapid setting patching material from the Qualified Products List No. 24. Surface preparation, mixing, equipment, and application shall be in accordance with the manufacturer's recommendations, except as amended herein. A four-hour minimum set retard time will be required for the patching material.

REINFORCING STEEL

Dimensions relating to reinforcing steel fabrication are out to out of bar unless otherwise noted. Dimensions relating to reinforcing steel spacing are center to center of bar. The minimum covering from the surface of the concrete to the face of any deformed reinforcing bar shall not be less than the following:

Top of slab = 50 mm
Bottom of slab = 25 mm [8]*

[8] Use 50 mm in areas where brackish or salt water is encountered.

All other reinforcing steel cover shall be 50 mm unless otherwise noted in the plans. See standard plan SWBS-100 (M) for bar supports for reinforcing steel.

When epoxy coated reinforcing is specified, all bar supports and tie wire in contact with the epoxy coated rebar shall be non corrosive and non conductive. See Standard Plan SWBS-100 (M) for bar supports for reinforcing steel. All reinforcing steel shall be grade 420. All reinforcing steel is designed and detailed as metric. Bar designations are specified with the prefix "B" followed by the bar size and mark.

The contractor will be allowed to substitute english for metric bars. The substitution shall be made on a one to one basis for the designated metric bar. The substitution will be made at no additional pay.

TABLE FOR REINFORCING BAR SIZE SUBSTITUTIONS (english for metric)		
HARD METRIC	SOFT METRIC	**ENGLISH**
10	13	**4**
15	16	**5**
20	22	**7**
25	25	**8**
30	32	**10**
35	36	**11**

PILES

The pile notes are dependent on several factors particular to each project. See chapter 6 for detailed notes and information.

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DRILLED SHAFTS

Drilled shafts size, type, length, and maximum design load shall be described in the plans and project specifications. All excavation or fill shall be complete prior to the installation of drilled shafts affected.

PRESTRESSED GIRDERS

For general notes on precast-prestressed concrete girders, see Miscellaneous Span and Girder Details. For spans without intermediate diaphragms, the contractor will be required to provide bracing between girders to ensure stability and proper alignment during erection and pouring sequence.

OPTIONAL DECK FORMING SYSTEMS

Optional Span Details: The contractor may use precast-prestressed optional span details. See the plans and the Standard Specifications.

Galvanized Stay-In-Place Metal Forms: The contractor will be allowed to use galvanized stay-in-place metal forms provided the use of the forms does not add weight or thickness to the concrete deck. The stay-in-place forms must conform to ASTM A 653M (table 1) designation G165.

EXISTING BRIDGE REMOVAL

The existing bridge to be removed under item 202(02)(A)( ), per each, includes the following structure:

Structure Number:_____

The contractor is to remove all parts of the existing bridge in their entirety as stipulated in the Construction Specifications. Salvageable existing guardrails shall be hauled and unloaded by the contractor to the _____maintenance unit, (at no direct pay). All other materials shall become property of the contractor and disposed of by the contractor outside the limits of the right-of-way.

STRUCTURAL METALWORK

Steel (minor)

Structural Steel: All steel shall be structural carbon steel conforming to ASTM A 709M (GR250) unless otherwise shown in the plans. Any necessary substitution must have prior approval of the Bridge Design Engineer. Anchor bolts, nuts and washers shall be hot dipped galvanized. Payment for structural steel is made under item 807(06), Structural Metalwork, per lump sum.

Steel (major)

Structural Metalwork: Unless indicated in the plans, all structural steel shall be structural carbon steel in accordance with ASTM A 709M, (GR250). High strength low-alloy steel shall be in accordance with ASTM A 709M, (GR345) or A 709M, (GR345W). . All steel shall be positioned in the members or splice plates so as to place the direction of finish rolling parallel to the direction of primary stress. For continuous spans, detailed erection drawings outlining complete procedures along with the equipment to be used for erection shall be submitted to the Bridge Design Engineer for approval.

Welding Items

Welding: Welding of all structural steel and steel pipes shall conform to Section 815 welding of the Louisiana Standard Specifications for Roads and Bridges.

Bolted Connections

All field connections shall be made with high strength bolts conforming to ASTM A 325. Bolt spacing shall be in accordance with design drawings, shop drawings, and the requirements of design specifications. Unless otherwise shown, bolted connections shall be made with 22 mm diameter high strength bolts. One washer will be required beneath the turning element. Bolted connections are designed as friction type.

Galvanized Steel

All miscellaneous hardware which is specified to be galvanized shall be coated in accordance with ASTM A 153. All structural steel shapes which are specified to be galvanized shall be coated in conformance with ASTM A 123 after fabrication. Damaged galvanized coats that are not to be embedded in more than 75 mm of concrete shall be repaired with cold applied, zinc rich, organic paint, from the approved Qualified Products List or any other approved method of repair.

Charpy V-notch Testing

All structural members described below are designed as primary members and shall meet the longitudinal charpy V-notch test described in subsection 1013.01 of the Standard Specifications:

1. Tension flanges, webs and splice plates.

2. Stringers and stringer splice plates.

3. Specific members noted elsewhere in the plans.

4. Longitudinal stiffeners in tension areas.

Fracture Critical Members (FCM)

Members noted as "FCM" in the plans shall meet the requirements that are provided in the project specifications. Heat numbers shall be shown on the shop drawings for all FCM noted members.

Erection

Detailed erection drawings outlining the procedure and equipment to be used shall be submitted to the Bridge Design Engineer for approval.